Translation

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Form PCT/IPEA/416
1.2061 a PCT		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/DE2004/000315	20.02.2004	21.03.2003
International Patent Classification (IPC) or national classification and IPC		
Applicant		
FORSCHUNGSZENTRUM JÜLICH GMBH		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 12 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. ☒ *(sent to the applicant and to the International Bureau)* a total of 1 sheets, as follows:
      ☐ sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s))

      _____, containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:

☒	Box No. I	Basis of the report
☐	Box No. II	Priority
☒	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
☐	Box No. IV	Lack of unity of invention
☒	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
☐	Box No. VI	Certain documents cited
☒	Box No. VII	Certain defects in the international application
☒	Box No. VIII	Certain observations on the international application

Date of submission of the demand	Date of completion of this report
Name and mailing address of the IPEA/EP	Authorized officer
Facsimile No.	Telephone No.

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Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ This report is based on translations from the original language into the following language _____, which is the language of a translation furnished for the purposes of:

☐ international search (Rule 12.3 and 23.1(b))

☐ publication of the international application (Rule 12.4)

☐ international preliminary examination (Rule 55.2 and/or 55.3)

2. With regard to the **elements** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

☐ the international application as originally filed/furnished

☒ the description:

pages 1-15 as originally filed/furnished

pages* _____ received by this Authority on _____

pages* _____ received by this Authority on _____

☒ the claims:

nos. _____ as originally filed/furnished

nos.* _____ as amended (together with any statement) under Article 19

nos.* 1 received by this Authority on 21.01.2005 with the letter of 21.01.2005

nos.* _____ received by this Authority on _____

☒ the drawings:

sheets 1/5-5/5 as originally filed/furnished

sheets* _____ received by this Authority on _____

sheets* _____ received by this Authority on _____

☐ a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3. ☒ The amendments have resulted in the cancellation of:

☐ the description, pages _____

☒ the claims, nos. 2-17

☐ the drawings, sheets/figs _____

☐ the sequence listing *(specify)*: _____

☐ any table(s) related to sequence listing *(specify)*: _____

4. ☒ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

☐ the description, pages _____

☒ the claims, nos. 1

☐ the drawings, sheets/figs _____

☐ the sequence listing *(specify)*: _____

☐ any table(s) related to sequence listing *(specify)*: _____

* *If item 4 applies, some or all of those sheets may be marked "superseded."*

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Box No. III **Non-establishment of opinion with regard to novelty, inventive step and industrial applicability**

The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non obvious), or to be industrially applicable have not been examined in respect of:

☐ the entire international application

☒ claims Nos. 1

because:

☐ the said international application, or the said claims Nos. _____
relate to the following subject matter which does not require an international preliminary examination (*specify*):

☐ the description, claims or drawings *(indicate particular elements below)* or said claims Nos. _____
are so unclear that no meaningful opinion could be formed (*specify*):

☒ the claims, or said claims Nos. 1 are so inadequately supported by the description that no meaningful opinion could be formed.

☐ no international search report has been established for said claims Nos. _____

☐ the nucleotide and/or amino acid sequence listing does not comply with the standard provided for in Annex C of the Administrative Instructions in that:

the written form
- ☐ has not been furnished
- ☐ does not comply with the standard

the computer readable form
- ☐ has not been furnished
- ☐ does not comply with the standard

☐ the tables related to the nucleotide and/or amino acid sequence listing, if in computer readable form only, do not comply with the technical requirements provided for in Annex C-*bis* of the Administrative Instructions.

☐ See Supplemental Box for further details.

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Box No. V **Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims		YES
	Claims		NO
Inventive step (IS)	Claims		YES
	Claims		NO
Industrial applicability (IA)	Claims		YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

1. This report refers to the following search report citations; the same numbering will be used throughout the proceedings:

D1: US 2001/021593 A1 (TAKAMATSU YUKICHI ET AL) 13 September 2001 (2001-09-13)

D2: EP-A-1 207 215 (NGK INSULATORS LTD) 22 May 2002 (2002-05-22)

D3: US-A-5 494 521 (MATSUI YASUSHI ET AL) 27 February 1996 (1996-02-27)

D4: EP-A-1 108 468 (IPS LTD) 20 June 2001 (2001-06-20)

D5: DE 101 18 130 A (AIXTRON AG) 17 October 2002 (2002-10-17)

2. Prior art

2.1 D1 indicates a CVD system and a CVD method for depositing semiconductor films (abstract). The design (figure 1) is similar to that of figure 1 of the present application. The gas inlet system 5 has a first passage 10 and a second passage 11 [0033]. To deposit GaN (example 1, [0059-0065]) on a sapphire substrate, a

mixture of NH_3 and H_2 is introduced through the first passage and a mixture of trimethylgallium and H_2 through the second passage. Thus, a gas flow is obtained in which the trimethylgallium / H_2 mixture is situated between the NH_3/H_2 mixture.

Furthermore, D1 already deals with the problem addressed by the present application, namely that of preventing the deposition of material on the chamber walls of the CVD reactor [0009]. It is stated that it belongs to the prior art to use a non-reactive protective gas about the reactive gases [0010] and a gas inlet 8 is provided therefor in the system shown in figure 1.

2.2 D2 describes a method for producing a III-V semiconductor film (abstract). In the reactor shown in figure 2, to deposit an AlN film on a substrate, e.g. sapphire [0028], a mixture of trimethyl aluminium and H_2 is fed through the passage 18, NH_3 is fed through the passage 19, and H_2 or N_2 are fed through the uppermost passage in figure 2. This ensures that the precursor gases are supplied efficiently to the substrate and not areas distant therefrom [0024]. The design of the device as per figure 2 is virtually identical to that of figure 1 of the present application. In D2 too, a gas mixture is obtained that is layered such that the organometallic compound is situated between the substrate and the group V or group VI compound. Since a certain mixing of the gases will occur at least at the border layer between the NH_3 and the H_2 or N_2 layer, there is also a layer comprising a group V or group VI compound with a support gas.

D2 also addresses the problem of particle formation

[0007-0010] and to this end envisages the deposition of an AlGaInN on the substrate holder [0014].

2.3 D3 discloses an MOCVD system for the deposition of III-V semiconductor films, in which organometallic precursors can be removed from various sources and fed into the chamber via gas lines (abstract and figure 1). Each gas line, e.g. line 87, is connected to a valve 4 and a valve 5 which allow the respective precursor to be fed to two different gas inlets in the chamber. The number 10 in figure 1 characterises a mass flow meter (column 6, lines 31-41).

2.4 D4 also indicates a CVD system for depositing compound semiconductors (abstract and [0002]) in which gases can be fed from supply containers 416, 426 via gas lines and a plurality of valves to two inlets of a reactor chamber 100 (figure 1).

2.5 Compound semiconductors, such as, e.g., GaN, GaAlN or GaInN, are likewise deposited in D5 [0020, 0035]. The process starts with the metal halogenides which are introduced together with H_2 as a support gas between the substrate and a gas layer from an elementary hydrogen of the V main group [0020, 1, 2, 4-7].

3. Novelty (PCT Article 33(2))

The device shown in figure 5 is novel, since D1, D2 and D5 do not mention the use of valves.
It is novel over D3 and D4, since the devices shown in

these documents do not have a divider plate.
If claim 1 were to be amended in accordance with the comments made Box 1, it would therefore be considered novel.

4. Inventive step (PCT Article 33(3))

D1 and D2 describe reactors for depositing compound semiconductors, e.g. III-V- semiconductors, in which the reactants are separated in the reaction chamber by a divider plate. However, these documents do not give any details as to the structures of the system which are required to prepare the reaction gases, supply them to the reactor and control the flow thereof.
It is general knowledge in the art that gas supply containers with support gas and reaction gas are used and the gases are controlled using valves. In D3, a system such as this is used for preparing and handling reaction gases and is employed in the deposition of III-V semiconductors.
A person skilled in the art addressing the problem of which system to use to prepare and handle reaction gases so as to carry out the method indicated in D1 and D2 would consider the system of D3, since it relates to the same type of deposition material as D1 and D2 and offers, in addition, the advantages indicated in the abstract.
The combination of D1 or D2 with D3 leads to a device with two gas collection lines, a divider plate in the reactor, and two valves via which a gas source can be connected to either gas collection line.
The device according to figure 5 of the present application is, in principle, similar to the device that

can be derived from a combination of D1 or D2 with D3. However, it differs from the latter in the use of 3/2 way valves.

In the device suggested by a combination of D1 or D2 with D3, the problem arises that there can be a significant mixing of the reaction gases already in the lines, namely if valves simultaneously connect the different gas sources to a collection line, e.g., if, during a gas exchange process or by mistake, these valves are opened at the same time. This mixing of gases can lead to the formation of particles, which is, as is well known, a highly undesirable phenomenon.

This problem is solved as per the device of figure 5 of the present application by the use of 3/2 way valves, since in these valves, always either one or the other gas collection line is connected to a gas source.

Since none of documents D1-D5 mentions 3/2 way valves, nor suggests the use thereof, if claim 1 were to be amended in accordance with the comments made in Box I, it would be considered inventive.

5. Industrial applicability

If claim 1 were to be amended in accordance with the comments made in Box I, it would meet the requirements of industrial applicability (PCT Article 33(4)), since the technical subject matter of the present application can be made or used in industry, in a technical sense.

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Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

The present application does not meet the requirements of PCT Rule 5.1(a)(ii) since it does not indicate the relevant prior art, e.g. D1 and D2, or briefly discuss the essential content disclosed therein.

Box No. VIII **Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

Clarity (PCT Article 6)

1. Independent claim 1 is insufficiently supported by the description since the latter does not identify in its introductory part the subject matter of this claim and its technical effects as the invention.

2. Figures 1 and 4a belong to the prior art, but are not characterised as such.

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:

Box I, III

Box I:

Claim 1 does not meet the requirements of PCT Article 34(2)(b) since its content goes beyond the original disclosure, for the following reasons.

a) Claim 1 cannot be deemed a combination of the original sole device claims 15 and 16 since claim 1 contains additional technical elements (e.g. "3/2 way valve", "divider plate").

b) However, claim 1 is considered a generalisation with respect to pages 11 and 12 of the description and the system shown in figure 5. Thus, claim 1 does not contain, for example, the fact that a process gas is introduced into one side of the compartment and the other process gas on the other side. Similarly, the technical element that the gases can be interchanged is missing. Nor is it stated that the gas inlets are connected via the valves to the supply containers. And finally, figure 5 shows a device and pages 11 and 12 describe same which has exactly two and not at least two gas inlets.

The following examination therefore relates to the system whose manner of functioning is shown in figure 5 and described on pages 11 and 12 (see also PCT Rule 70.2(c)).

Box III:

Claim 1 goes beyond the version of the application as filed (see comments pertaining to Box I above) and is

Supplemental Box

therefore not supported by the text of the description and the drawings.